Burials at St Mary Magdalene, Boveney?

The small chapel of St Mary Magdalene lies in the south of Buckinghamshire, not far from Windsor and Eton. Now only used for occasional services, it is looked after by the Friends of Friendless Churches. It is a lovely little chapel, and well worth a visit (Fig. 1).

Figure 1: the chapel of St Mary Magdalene.

We were contacted via the Buckinghamshire Archaeological Society's Active Archaeology Group to see if we would undertake a geophysical survey around the chapel. The question was deceptively simple: are there graves around the church? The reason for the question is partly because, usually, 'chapels of ease' were not used for burial, and partly because the nearness of the water table makes digging deep holes problematic. Although the site is a long way out of our usual area, we agreed to try and see what we could find.

Three things make the job difficult:

1. burials are notoriously difficult to detect at the best of times. They aren't very big, and usually the same soil that came out of the hole goes back in again pretty quickly. There is, therefore, relatively little contrast between the grave fill and the surrounding soil.
2. Small areas are difficult to interpret. The whole churchyard is only 0.07ha (less than two 20x20m grid squares), and you have to subtract the footprint of the church itself and the path.
3. GPR surveys near standing buildings suffer from airwaves. Although the antennae are shielded, some of the radar signal will 'leak' and will bounce off nearby buildings etc. Airwaves can be seen in the data as having hyperbolas with a much flatter profile than the usual point sources in the ground such as rocks or walls.

Given the very small size of the area, and the surrounding metal fence, magnetometry survey was going to be pointless. Often, the best method for finding graves is GPR, and so that was our primary method (Fig. 2). Due to the building, and the odd shape of the church yard, we had to do the survey in six small blocks at 25cm intervals. Although it would have been easier to do the survey east-west, if we are trying to find graves working north-south would be more effective allowing the transects to cut across the grave rather than along it. Lastly, we decided to try the multi-depth Earth Resistance survey, aka 'the beast' (Fig. 3).

Figure 2: the GPR in action at Boveney. Photo: © Mike Smith.

Figure 3: the 'beast' in action at Boveney.

We all headed off to Bucks on a cold and slightly damp Sunday at the end of January (yes, I know this posting is late!) and we were assisted by members of the Bucks ASAAG. Both GPR and resistance surveys were awkward due to the small space we had available. The site is also very busy with walkers, cyclists and people enjoying their Sunday.

The idea of "the beast" is that the depth to which an Earth Resistance survey will measure is proportional to the distance between the mobile probes on the frame. The two remote probes have to be at least 45m away! Each time the machine is moved, it takes seven readings: one between two probes 25cm apart, one at 50cm, 75cm, 100cm, 125cm and 150cm. Yes, that makes six. Just for comparison, the seventh measurement is taken using a "Wenner array". This simply means that instead of using the two remote probes at the end of the cable, it uses the two outer probes on the frame to pass the current, and the two inner probes to take the reading. This is an older method for laying out probes that has generally been abandoned in archaeology, although it can be useful in circumstances when having remote probes at the end of the long cable is impossible. The results for all seven readings are shown in Figure 4.

Figure 4: results from the multi-depth Earth Resistance survey. (Click for larger image.)

Figure 4 looks a little odd because the satellite that took that image was clearly passing overhead a little to the south-east. It is, however, the best one available on Google Earth Pro. Comparing the various surveys at different depths, there is very little difference between them. Unsurprisingly, near the walls are areas of high resistance, possibly due to the foundations. The path was a pain. One problem was a number of 'spikes' in the data. These were probably caused by the rabbit holes: a hole with air is going to be high resistance (in fact the current passes through the soil around the hole). I worry slightly that processing those out may also have processed out the graves, but somehow I doubt it. It doesn't look like we detected any graves with this method.

The GPR survey was processed using the package GPR Slice. Figure 5 shows all the slices from the survey. These were processed using 2.92ns slices with a slight over-lap between them.

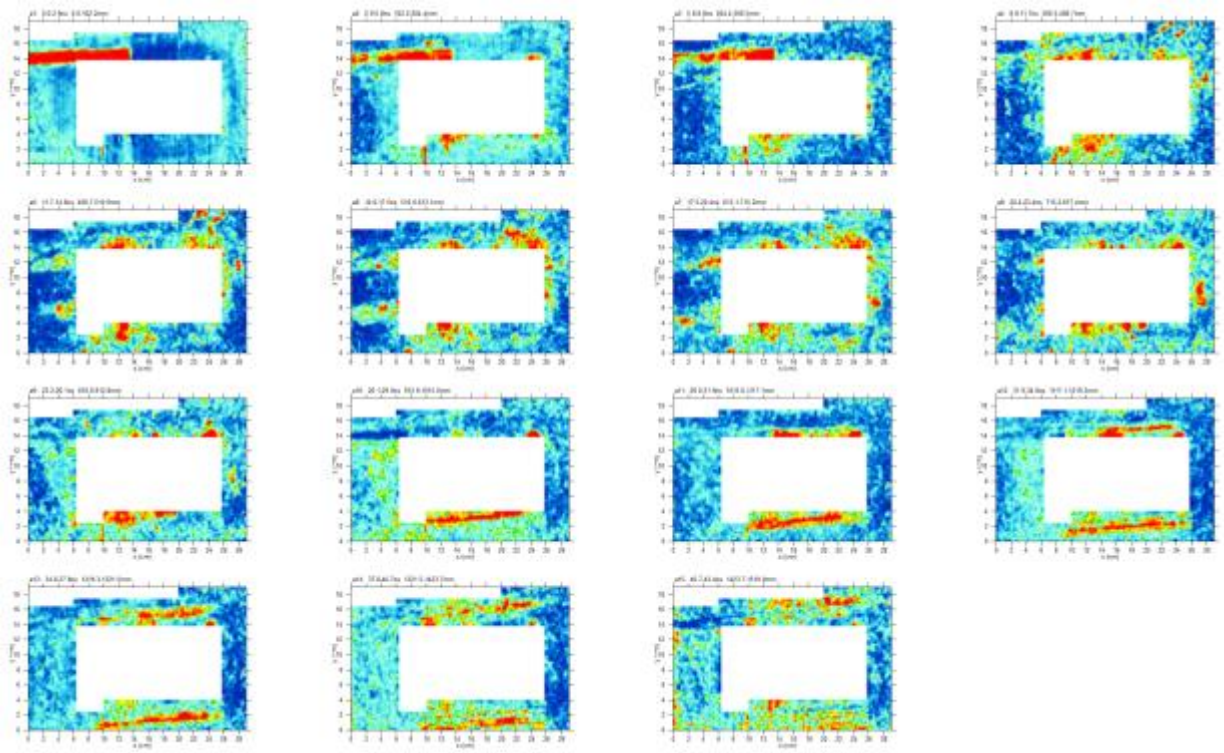

Figure 5: the time slices from Boveney.

The bright red line in the first slice is the path to the north entrance of the chapel. If you look at the image on Google Earth, one can see the south entrance too as a lighter blue line (Fig. 6). Not an Earth-shattering observation, but it is always encouraging when one can see the obvious!

Figure 6: GPR time slice 1.

What seems interesting, at first, at the strong reflections (shown in red) in the lower slices. They are at a slight angle to the hole in the survey where the church is. Looking at slice 11 in more detail (Fig. 7) we can see they are parallel to the wall… it is my grid that is at a slight angle. (The grid was set-up along the southern fence line.)

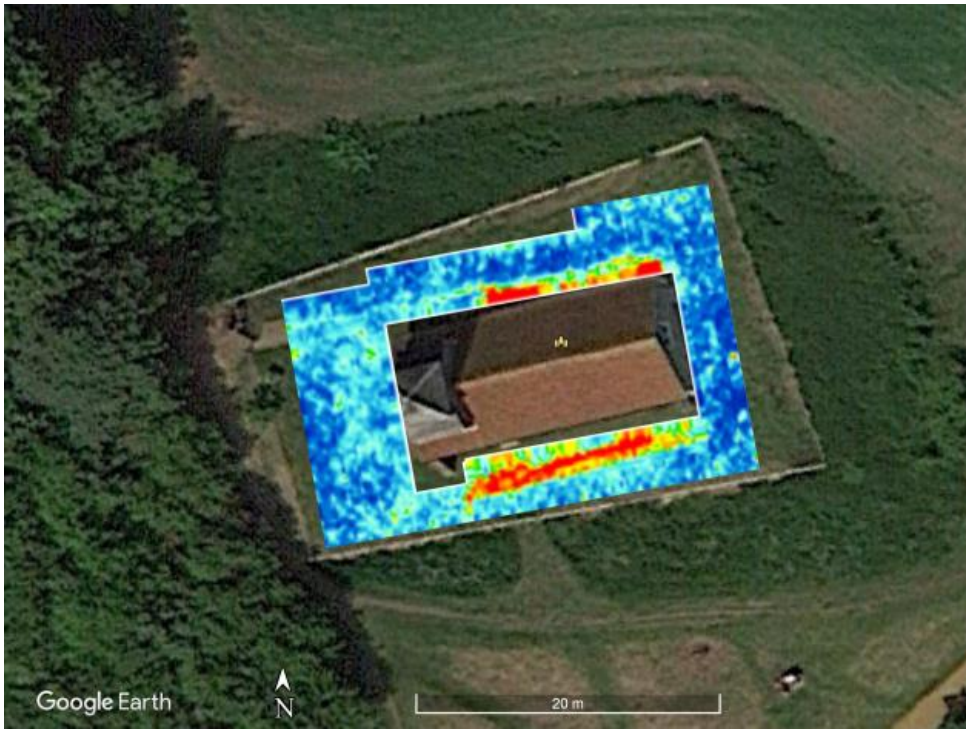

Figure 7: GPR time slice 11.

If we look at the radar data in 3D, we can see these strong reflections low down curving-up towards the edge of the survey (Figure 8). You can see those strong reflections intersecting with the red line in the time slice (labelled 'air waves').

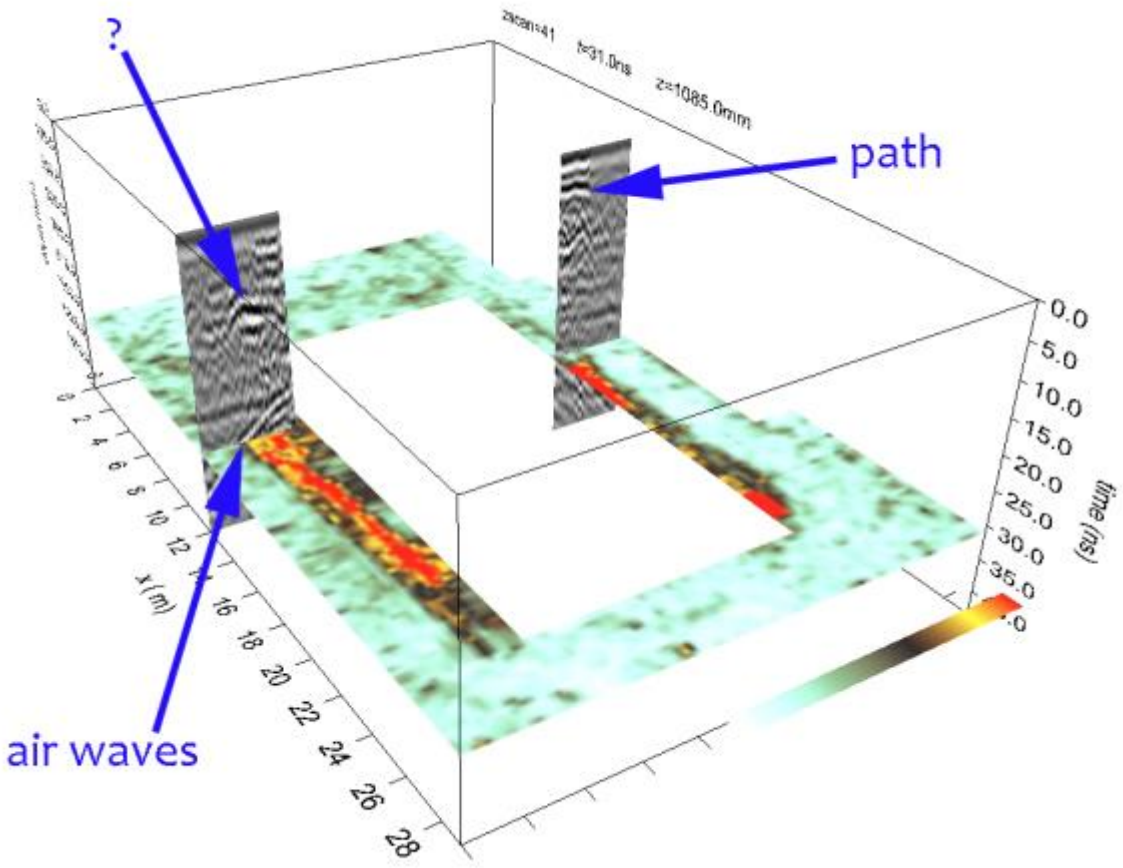

Figure 8: 3D image of the radar data.

To understand what is happening, we need to go back to GPR basics. What is happening when we do a survey?

1. The transmitting antenna sends out a radar pulse. Due to the shielding, most of this goes down into the ground, but some will leak out and bounce around like echos.
2. The receiving antenna measures the returning radar waves. It records two things: the strength of the signal (amplitude) and the time since the pulse was transmitted.
3. The software plots the strength of the return signal in shades of grey. Strong returns are plotted in black and white, and weaker returns in mid-greys. These are plotted as a single vertical band below the centre point of the antenna. The radargram one looks at on the screen are all these vertical bands added together to give the overall image.
4. Because the longer the time between the pulse and the return, the weaker the signal will be, we apply a 'gain curve' to the data. This is just a multiplication factor so that the deep returns are visible compared to the shallow ones.
5. As we push the GPR towards a wall, some of the signal will bounce off that wall. At first, the distance between us and the wall is relatively large, so the reflection will be plotted by the software low down the profile. As we get closer, the time taken for the signal to bounce off the wall gets less, and so the reflection is plotted higher up the profile. As a result, the signals bouncing off the wall will show as a gently rising curve.

6. Radar waves travelling through the air travel at the speed of light. Radar travelling through the soil is much slower. As a result, curves in our data which are quite steep are the result of a reflection from something in the soil. Very gentle curves are "air waves" and are the result of the radar bouncing off buildings, or even the underside of tree canopies.

To cut a long story short, the strong, deep reflections are airwaves caused by the radar bouncing off the walls of the chapel. Figure 9 shows the southern radargram from Figure 8 with some of the relevant reflections indicated.

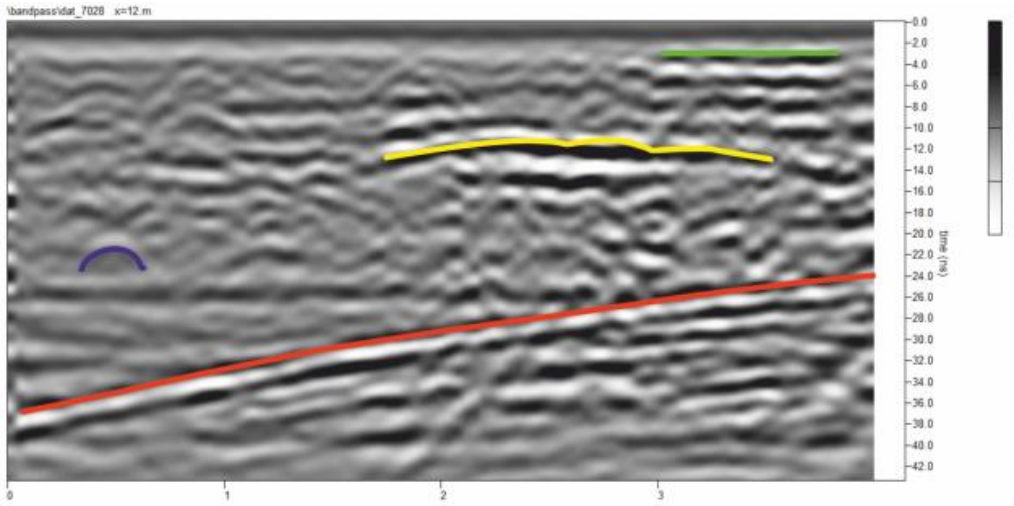

Figure 9: Radargram 7028 at 12m east with some reflections marked (see text).

In Figure 9 the airwave has been marked in red. See how it is a gentle curve across the radargram. A more normal hyperbola from a point source is indicated in purple. The green line near the surface represents the compacted soil outside the south door. Notice how there are bands of strong reflections below it. These are like echos. There is another, deeper, surface marked in yellow. I'm not sure what this it, perhaps an earlier entrance path? If we look at time slice 5, we can see this area of high reflections outside the south entrance to the chapel (Fig. 10).

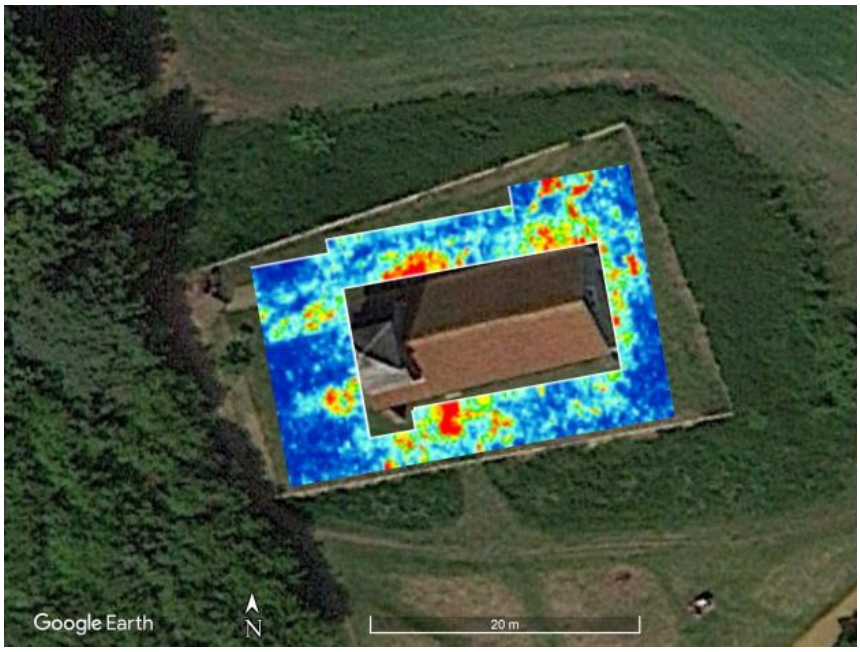

Figure 10: GPR time slice 5.

Archaeologists, (me included!), dislike looking at radargrams as they find them confusing (they are). Often one will see reports with only the time slices presented. One thing I have learnt from Larry Conyers, however, is that it is vital to look at both the time slices *and* the radargrams if one wants to understand in detail what is happening. Although in general I am not a fan of pseudo-3D representations of things (don't get me started on the invention of the Devil, the 3D pie-chart!), the 3D plots in GPR Slice do help work out what is going on.

So the million dollar question is: have we found any graves? The short answer is: none that I can see. The long answer is, sadly, that that does not mean there are no graves. Geophysics does not detect everything, as much as we would like it to. Also, I need to spend some more time going through the radargrams and trying to see if there are graves which show in the vertical radargrams but do not show in the horizontal time slices. Later this year I plan to spend some time with a friend in the US who does this sort of thing all the time, having a look at the data from this site and a couple of others in the hopes I have missed something vital. Watch this space!

This entry was posted in Boveney and tagged ahrc, Boveney, Buckinghamshire, Buckinghamshire Archaeological Society, burials, CAGG, church, community archaeology, earth resistance survey, geophysical survey, Geoscan RM85, GPR, GPR Slice, Ground Penetrating Radar, multiplexed survey, SEAHA, ucl on April 2, 2019.